

# MATERIALS SCIENCE & ENG (MS&E)

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**MS&E 5000 Special Problems** (IND 0.0-6.0)

Problems or readings on specific subjects or projects in the department. Consent of instructor required.

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**MS&E 5001 Special Topics** (LEC 0.0-6.0)

This course is designed to give the department an opportunity to test a new course. Variable title.

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**MS&E 5010 Seminar** (RSD 0.0-6.0)

(Variable) Discussion of current topics.

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**MS&E 5040 Oral Examination** (IND 0.0)

(Variable) After completion of all other program requirements, oral examinations for on-campus M.S./Ph.D students may be processed during intercession. Off-campus M.S. students must be enrolled in an oral examination and must have paid an oral examination fee at the time of the defense/comprehensive examination (oral/written). All other students must enroll for credit commensurate with uses made of facilities and/or faculties. In no case shall this be for less than three (3) semester hours for resident students.

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**MS&E 5060 Chemistry of Construction Materials** (LEC 3.0)

The objective of the course is to utilize fundamental concepts of materials science and chemistry to understand, analyze, and describe the chemistry of construction materials. Special focus is given to describe composition-reactivity-microstructure-property relations in various cementitious materials. Prerequisites: At least Senior standing.

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**MS&E 5099 Research** (IND 0.0-15)

(Variable) Investigations of an advanced nature leading to the preparation of a thesis or dissertation. Consent of instructor required.

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**MS&E 5210 Tissue Engineering** (LEC 3.0)

The course will use problem-based case studies to introduce junior and senior undergraduate students to the principles and clinical applications of tissue engineering. Topics include the use of biomaterials, scaffolds, cells, and external factors to develop implantable parts for the restoration, maintenance, or replacement of tissues and organs. Prerequisite: Junior or Senior standing. (Co-listed with Bio Sci 5240).

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**MS&E 5220 Advanced Phase Equilibria** (LEC 3.0)

Advanced aspects of unary, binary and ternary organic, phase equilibria. Includes practical examples of the applications of phase diagrams to solve engineering problems. Prerequisite: Graduate standing.

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**MS&E 5230 Energy Materials** (LEC 3.0)

The objectives of the course are to understand how the rational design and improvement of chemical and physical properties of materials can lead to energy alternatives that can compete with existing technologies. Discussions on the present and future energy needs from a view point of multidisciplinary scientific and technological approaches. Prerequisite: Senior standing.

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**MS&E 5310 Biomaterials I** (LEC 3.0)

This course will introduce senior undergraduate students to a broad array of topics in biomaterials, including ceramic, metallic, and polymeric biomaterials for in vivo use, basic concepts related to cells and tissues, host reactions to biomaterials, biomaterials-tissue compatibility, and degradation of biomaterials. Prerequisites: Senior undergraduate standing. (Co-listed with BIO SCI 5210, CHEM ENG 5200).

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**MS&E 5460 Molecular Engineering of Materials** (LEC 3.0)

This course focuses on the fundamentals of molecular engineering with an emphasis on their applications including renewable/clean energy solutions, energy storage, air/water cleaning, and optoelectronics. Topics include principles of modern physics, carbon chemistry, macromolecules, metal(covalent)-organic frameworks sol-gel processing and crystal growth. Prerequisites: Senior Standing or consent of instructor. (Co-listed with Chem 5460).

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**MS&E 5517 Materials Selection in Mechanical Design** (LEC 3.0)

This course will introduce the basics of materials selection in mechanical design. It will also introduce the benefits of computational materials and process selection. The students will also learn to use a commercially available materials selection software. This course will be offered as Distance Ed. Prerequisite: Met Eng 2110.

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**MS&E 5810 Introduction to Polymeric Materials** (LEC 3.0)

A basic study of the organic chemistry of natural and synthetic high polymers, their inherent properties and their uses in plastic, fiber, rubber, resin, food, paper and soap industries. Credit may not be given for both Chem 5810 and Chem 4810. Prerequisite: Chem 1320. (Co-listed with Chem 5810 and Chem Eng 5810).

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**MS&E 5819 Polymer Synthesis and Characterization Lab** (LAB 1.0)

Laboratory experiments dealing with polymerization syntheses and solution, bulk and solid properties will be presented. Each student will prepare polymers and carry out all characterization experiments on actual samples. Credit may not be given for both Chem 5819 and Chem 4819. Prerequisite: Chem 4810 or MS&E 4810 or Chem 5810 or MS&E 5810 or Chem Eng 5310, preceded or accompanied by Chem 1100 or Chem 5100 or an equivalent training program approved by S&T. (Co-listed with Chem 5819).

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**MS&E 5850 Introduction to Coating Chemistry** (LEC 3.0)

Study of the basic principles of protective coatings with particular reference to the paint and varnish industry. Classifications, manufacture, properties and uses of protective coatings. Credit may not be given for both Chem 5850 and Chem 4850. Prerequisite: Chem 1320 or Met Eng 1210. (Co-listed with Chem 5850).

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**MS&E 6000 Special Problems** (IND 0.0-6.0)

Problems or readings on specific subjects or projects in the department. Consent of instructor required.

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**MS&E 6001 Special Topics** (LEC 0.0-6.0)

This course is designed to give the department an opportunity to test a new course. Variable title.

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**MS&E 6010 Seminar** (RSD 0.0-6.0)  
(Variable) Discussion of current topics.

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**MS&E 6050 Continuous Registration** (IND 1.0)  
Doctoral candidates who have completed all requirements for the degree except the dissertation and are away from the campus must continue to enroll for at least one hour of credit each registration period until the degree is completed. Failure to do so may invalidate the candidacy. Billing will be automatic as will registration upon payment.

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**MS&E 6060 Advanced Chemistry of Construction Materials** (LEC 3.0)  
To describe fundamental composition-reactivity-microstructure-property relationships in construction materials. Tests will include quizzes, written-exams, as well as a term paper and a presentation on a topic relevant to the course.

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**MS&E 6085 Internship** (IND 0.0-15)  
(Variable) Students working toward a doctor of engineering degree will select with the advice of their committees, appropriate problems for preparation of a dissertation. The problem selected and internship plan must conform to the purpose of providing a high level engineering experience consistent with the intent of the doctor of engineering degree.

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**MS&E 6099 Research** (IND 0.0-15)  
(Variable) Investigations of an advanced nature leading to the preparation of a thesis or dissertation. Consent of instructor required.

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**MS&E 6110 Bonding, Crystallography, and Structure-Property Relationships** (LEC 3.0)  
Principles of electronic structure and chemical bonding in solids and their relationships to electrical, mechanical, thermal, and optical properties. An exploration of reciprocal lattices and tensor properties of crystals; consideration of the impact of crystal symmetry on anisotropy. The influence of defects and grain boundary phenomena on material behavior. Prerequisite: Graduate standing, or undergraduate standing with instructor and advisor approval.

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**MS&E 6120 Thermodynamics and Phase Equilibria** (LEC 3.0)  
Classical thermodynamic treatment of materials and material processing based on the 1st and 2nd Laws of Thermodynamics and phase equilibria considerations. The course will cover equilibria in gaseous systems, gas-solid reactions including passive and active oxidation, solution thermodynamics, phase equilibria in solution systems, and electrochemistry. Prerequisite: Graduate standing, or undergraduate standing with instructor and advisor approval.

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**MS&E 6130 Kinetic Theory for Materials** (LEC 3.0)  
Phenomenological and atomistic theories of diffusion in materials including discussion of short circuit diffusion and ionic diffusion in an electric field. Fundamentals of phase transformation in materials; chemical fluctuation, nucleation and growth theory; kinetic models for evaluating and predicting diffusion controlled transformation kinetics. Prerequisite: Graduate standing, or undergraduate standing with instructor and advisor approval.

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**MS&E 6210 Advanced Tissue Engineering** (LEC 3.0)  
The course will introduce graduate students to the principles and clinical applications of tissue engineering including the use biomaterials, scaffolds, cells, and external factors to develop implantable parts for the restoration, maintenance, or replacement of tissues and organs. A related topic term paper and oral presentation are expected. Prerequisite: Graduate standing. (Co-listed with Bio Sci 6240).

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**MS&E 6220 Advanced Energy Materials** (LEC 3.0)  
The objectives of the graduate level course are to review the recent developments on advanced energy materials and systems in addition to basic understanding how chemical and physical properties of materials can lead to energy alternatives. Prerequisite: Graduate standing.

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**MS&E 6230 Nanomaterials** (LEC 3.0)  
Introduction of the fundamentals of nanomaterials and recent developments on nanomaterials. Topics include physical and chemical properties, synthesis, processing, and applications of nanomaterials. Example nanomaterials include nanoparticles, nanotubes, and nanowires. Students will need to complete a project related to nanomaterials. Prerequisite: Graduate Standing. (Co-listed with Chem Eng 6310).

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**MS&E 6310 Biomaterials II** (LEC 3.0)  
This course will introduce graduate students to a broad array of topics in biomaterials, including ceramic, metallic, and polymeric biomaterials for in vivo use, basic concepts related to cells and tissues, host reactions to biomaterials, biomaterials-tissue compatibility, and degradation of biomaterials. A term paper and oral presentation are required. (Co-listed with BIO SCI 6210, CHEM ENG 6300).

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**MS&E 6460 Advanced Molecular Engineering of Materials** (LEC 3.0)  
This advanced course focuses on the fundamentals of molecular science and engineering and their applications including renewable/clean energy solutions, energy storage, and optoelectronics. Topics include principles of carbon chemistry, macromolecules, metal(covalent)-organic frameworks, sol-gel processing, crystal growth and other advanced topics. Prerequisites: Graduate Standing or consent of instructor. (Co-listed with CHEM 6460).

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**MS&E 6820 Polymer Synthesis** (LEC 3.0)  
The methods of organic monomer and polymer syntheses will be explored. Mechanistic and structural components, modern and current industrial methods for polymer syntheses will be discussed. Topics include linear, branched, graft, and dendritic polymers, nano-technology and macromers. Prerequisites: Chem 4810 or MS&E 4810 or Chem 5810 or MS&E 5810; Chem 2220 or Chem 4210 or Chem 4220 or Chem 5210 or Chem 5220. (Co-listed with Chem 6820).

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**MS&E 6840 Polymer Physical Chemistry and Analysis** (LEC 3.0)  
A study of the physical properties of macromolecular systems including polymer solutions, gels, bulk polymers and rubbers. The chemical characterization of polymers based on their thermal, spectroscopic, microstructure and molecular weight is also discussed. Prerequisite: Chem 4810 or MS&E 4810 or Chem 5810 or MS&E 5810; thermodynamics. (Co-listed with Chem 6840).

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